MONTANA DEPARTMENT OF NATURAL
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DIVISION OF FORESTRY

INSECT AND DISEASE REPORT

Ground Application of Four Insecticides on Pine Butterfly Populations in Montana

1973 FIELD TESTS

REPORT 74-1

GROUND APPLICATION OF FOUR INSECTICIDES ON PINE BUTTERFLY POPULATIONS IN MONTANA-1973 FIELD TESTS

by

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ABSTRACT

Two dosages each of four insecticides, malathion, Zectran, stabilized pyrethrins and Resmethrin, were tested against pine butterfly larvae, Neophasia menapia (Felder & Felder), on ponderosa pine in the Bitterroot Valley near Florence, Montana, in June, 1973. Conventional ground spray equipment was used to treat 24 test clusters of 10 trees each. All treatments were highly successful, with corrected percent control ranging from 98.53 to 100.

INTRODUCTION

The pine butterfly, Neophasia menapia (Felder & Felder), when it reaches epidemic levels, is a serious defoliator of ponderosa pine, Pinus ponderosa (Laws). Considerable mortality of trees denuded of needles by feeding of the larvae can occur (Evenden, 1940 and Cole, 1971). Since 1893 there have been five documented pine butterfly outbreaks. The last of these was detected in the Bitterroot Valley of Montana in 1969 (Bousfield and Ciesla, 1971). By 1972, ponderosa pine on approximately 40,000 acres of State, private and National Forest lands in the Bitterroot Valley and near Missoula showed aerially visible defoliation (Dewey et.al., 1973). In addition to damage in the forest situation, a number of ponderosa pine serving as yard and shade trees suffered noticeable defoliation. Concern was expressed by many landowners who feared the loss of valuable trees from defoliation by pine butterfly larvae (Bousfield and Dewey, 1972).

Only one pine butterfly outbreak has been chemically treated. An estimated 255,400 acres of ponderosa pine on the Boise National Forest, Idaho, were aerially sprayed with DDT in 1964 (Cole, 1966). Ultimately less than one percent of the pine stand died. Since withdrawal of the EPA registration of DDT in 1971, home owners and land managers have been without a chemical tool for pine butterfly control.

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This field test was designed to lead to the registration of one or more non-persistent materials for pine butterfly control using ground application techniques. These chemicals would then be available to private home owners and forest managers to protect valuable trees in yards, recreation areas, etc., should the need arise in future years. Additional tests were conducted in 1973 by the U.S. Forest Service to find suitable materials for aerial application.

MATERIALS AND FORMULATION

A series of 14 short-lived insecticides has been laboratory screened and their effect on pine butterfly larvae compared to the effect of DDT (Lyon and Brown, 1971). All but one of the materials tested showed a greater contact toxicity to the pine butterfly than DDT. As a result of this insecticide screening and more recent laboratory testing, the following materials were selected for field testing:

1. Malathion
2. Zectran
3. Stabilized pyrethrins
4. Resmethrin

Reasons for the selection of each material follow:

1. Malathion - Malathion was 1.6 times as toxic as DDT to pine butterfly larvae treated in the laboratory. It also has a low mammalian toxicity. It is registered for use against many pests of vegetables, fruits, ornamentals and forests. It is relatively inexpensive and easy for the landowner interested in treating individual trees to obtain.

2. Zectran - Zectran was 2.4 times as toxic to pine butterfly larvae in the laboratory as DDT. It is currently registered and available for forest spraying against some other forest defoliators. Much is known on its behavior in the environment and on non-target organisms. It has a very low mammalian dermal toxicity.

3. Stabilized pyrethrins - This material was selected because of its high toxicity to pine butterfly larvae (62 times greater contact toxicity than DDT) and its low toxicity to vertebrates. Considerable data has been collected on its effect on other organisms.

4. Resmethrin - In recent laboratory tests this material resulted in high mortality levels when applied at low concentrations to larvae similar to the pine butterfly. It has very low persistence, being stable in sunlight for no more than a few hours.

Specific formulations used in the tests were: (1) Zectran - Zectran 2E Emulsifiable Concentrate, provided by Dow Chemical Co.; (2) Malathion - Cythion 8E premium grade malathion, emulsifiable liquid, purchased from Stauffer Chemical Co.; (3) Pyrethrins - MGK Pyrocide stabilized growers spray 7083 in a stabilized 1.4% emulsifiable concentrate, provided by McLaughlin Gormley King Co.; and (4) Resmethrin - SBP-1382-2 Emulsifiable Concentrate Xy, provided by S.B. Penick and Co.

Each of the materials was diluted with water to obtain dosages of .01 lb. per 10 gallons and .02 lb. per 10 gallons for both stabilized pyrethrins and Resmethrin; .05 lb. per 10 gallons and .075 lb. per 10 gallons for Zectran, and .21 lb. per 10 gallons and .83 lb. per 10 gallons for malathion.

Since cost of material is an important factor in consideration of individual tree treatment by landowners, costs of treatment with the four materials tested were computed and are compared to Table 1.

Table 1 . A list of insecticides and dosages selected for the ground application test and their respective costs.

Material	Cost/lb. Technical	Dosage	Cost of insecticide per gal. of final mix	Cost of insecticide at 10 gal. spray per tree
Stabilized Pyrethrins (Formula 7083)	$50.00	.01 lb/10 gal	.050	.50
		.02 lb/10 gal	.10	1.00
Resmethrin (24.3% SBP-1382-2EC)	48.00	.01 lb/10 gal	.048	.48
		.02 lb/10 gal	.096	.96
Zectran 2E	7.50	1 qt/100 gal (.05 lb/10 gal)	.037	.37
		1½ qt/100 gal (.075 lb/10 gal)	.056	.56
Malathion	1.00	¼% (.21 lb/10 gal)	.021	.21
		1% (.83 lb/10 gal)	.083	.83

TEST DESIGN

1. The ground spray tests were conducted on State and private lands in the Sweeney Creek drainage near Florence, Montana, and on private lands at Antrim Point on the east side of the Bitterroot River (Figure 1).

2. In total, 27 clusters of 10 trees each were selected at intervals along existing roads and old skid trails in the test areas (Figure 2). This was done so the clusters could be reached by the spray vehicle.

3. There were nine treatments (2 dosages of malathion, 2 dosages of Zectran, 2 dosages of stabilized pyrethrins, 2 dosages of Resmethrin and control) with three replications per treatment (one 10-tree cluster per replicate).

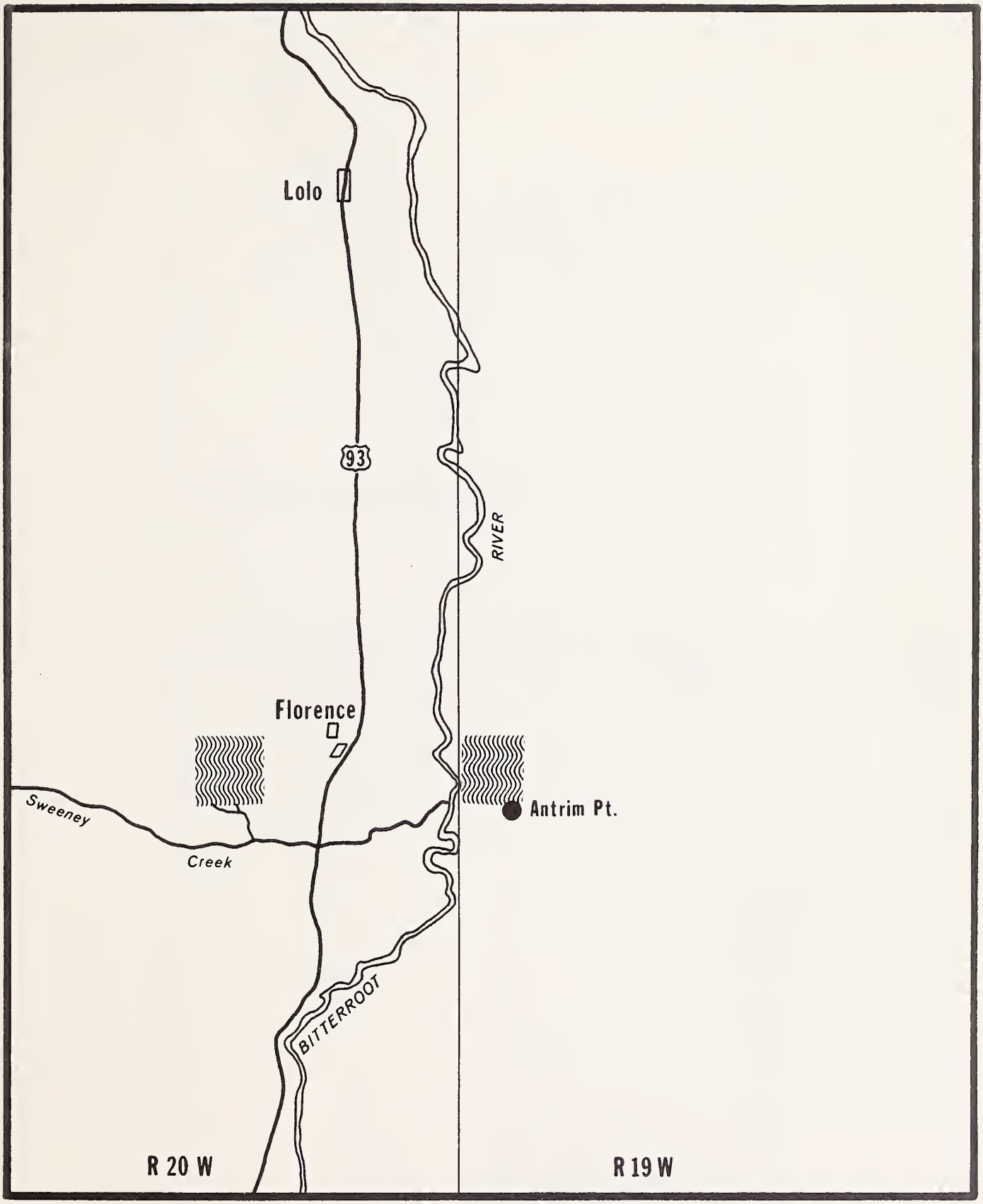

Figure 1. Location of 1973 ground spray test areas in the Bitterroot Valley, Montana

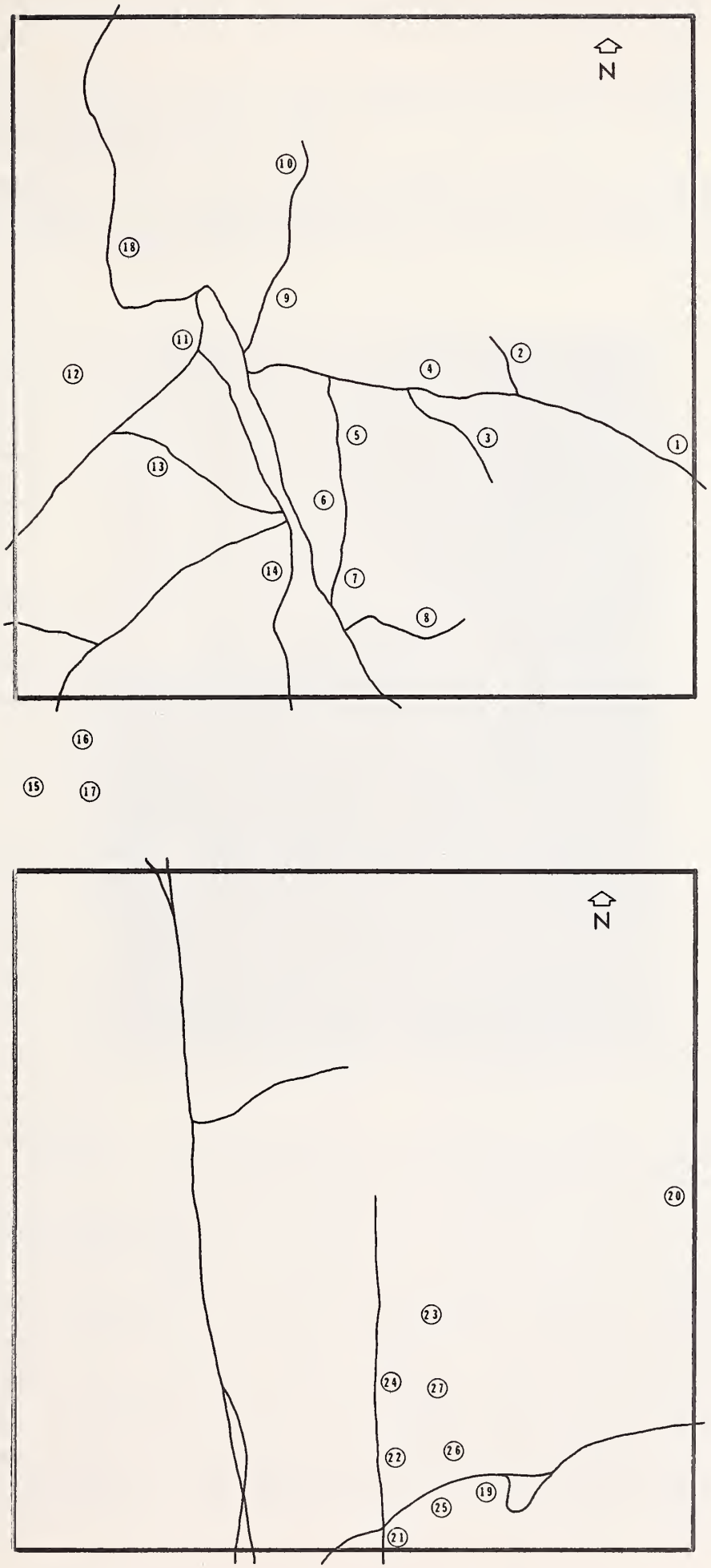

Figure 2. Location of test tree clusters in the 1973 ground spray test in Sweeney Creek (top) and at Antrim Point (bottom).

A distance of not less than approximately 100 yards was allowed between clusters to minimize spray drift.

4. Pine butterfly larvae populations on each tree were sampled by cutting six foliated branch tips (approximately 15 inches in length) from mid-crown of each tree with an extendable pole pruner with catch basket attached (Figure 3).

Figure 3. Collecting pine butterfly larvae samples.

All trees in each cluster were sampled immediately before spraying and again 4 days after spraying.

5. Individual sample trees in each cluster were 20 to 50 feet tall. Each tree selected was checked to make sure sufficient foliage remained to harbor high enough larvae populations to make the test statistically sound (not less than 6 larvae per sample branch). Trees taller than 50 feet were not selected because of limitations in the pole pruner used to clip sample branches and in the height to which spray could be directed efficiently from ground level. Trees were marked with a yellow paper tag giving the tree and cluster number and with streamers of red flagging to assist in relocating.

The design, then, consisted of 27 clusters of 10 trees each for a total of 270 trees. The choice of treatment for a particular cluster of 10 trees was random. A total of 1,620 branches was cut during each of the two sample periods. The basic sample unit was six approximately 15-inch branches taken from mid-crown. Pine butterfly larval population densities were expressed as the number of larvae per linear inch of foliated branch.

SPRAY APPLICATION

Spray applications were begun after development samples indicated egg hatch was completed. Larvae were in 1st and 2nd instar stages when sprayed. The four insecticides were randomly placed on the spray schedule. Resmethrin was sprayed on June 5, malathion on June 6, Zectran on June 9, and stabilized pyrethrins on June 10. All sprays were applied to the point of run-off using a Montana Division of Forestry fire pumper (Figures 4 and 5).

Figures 4 and 5. Application of ground sprays.

The fire pumper was equipped with a centrifugal four-stage WGC-4-SP Pacific pump connected to 200 feet of one-inch hard rubber hose. The nozzel used was an Elkhart Select-O-Flow, adjustable from 10 to 30 gallons flow per minute. The pump,

hose reel and a 500 gallon fiberglass tank were mounted on a 20,000 GVW Ford truck (Figure 6).

Figure 6. Equipment used in ground spray application.

Only one insecticide was applied on each spray day. Enough of each dosage was mixed in the tank to complete spraying of the three 10-tree clusters. The low dosage of each insecticide was applied first; then the tank was emptied and flushed before being filled with the high dosage. After diluting, the sprays were allowed to recirculate in the tank for approximately 10 minutes to insure complete mixing. At completion of spraying each day, the tank, hose and pump were flushed with Nutra-sol. The average amount of spray required to treat each tree was between five and ten gallons. A few larger, open-grown trees required more. Spray applicators wore protective clothing and a respirator when applying the material.

SPRAY ASSESSMENT

Pre-spray larval populations on trees in each cluster were sampled immediately before the spray was applied to the cluster. Post-spray populations were sampled 4 days after spraying. The check clusters were sampled June 7 and again June 11. Sampling was accomplished by cutting six branches, each approximately 15 inches long, from mid-crown of each sample tree with an extendable pole pruner. Branches fell into a cloth basket attached near the pruner head (Figure 3) and were lowered to the ground. Branches falling out of the basket were discarded and others cut in their place. The six sample branches from each tree

were placed in a plastic bag with a card indicating tree and cluster numbers and date. A separate bag was used for each tree. The plastic bags were placed in large canvas sacks which held 15-20 bags and were kept in a cool, shady location until sampling was completed. The canvas sacks containing the plastic bags with sample branches were then transported in a pickup truck to the laboratory in Stevensville.

Under supervision of an entomologist, insect counters in the laboratory removed foliage from the bags and placed all insects in petri-dishes. Pine butterfly larvae were counted and inches of foliage on the branches measured. Effectiveness of each insecticide and dosage was evaluated by comparing pre-spray and post-spray larval population counts on the sample branches. Results were expressed in terms of survival ratio and corrected percent control.

RESULTS

Results of the ground test spraying of the four insecticides against pine butterfly larvae are summarized in Table 2. Pre-spray and post-spray densities are expressed in the table as number of larvae per linear inch of foliated branch. The corrected percent control figures were computed by using the following formula to take into account the natural mortality:

$$100\left(1.0 - \frac{\text{survival treated}}{\text{survival control}}\right) = \text{corrected \% control}$$

All four insecticides were extremely successful in killing pine butterfly larvae at the dosages tested. As can be seen from Table 2, there was little difference between the high and low dosages for each material.

Table 2. Survival ratios of pine butterfly larvae treated by ground sprays of four insecticides.

Treatment	Cluster number	Pre-spray density[1]	Post-spray density[1]	Survival ratio	Corrected % Control[2]
Stabilized Pyrethrins .02 lb/10 gal.	6	.1285	.0042	.0328	
	19	.1807	.0000	.0000	
	25	.2090	.0000	.0000	
Average		.1727	.0014	.0081	98.78
Stabilized Pyrethrins .01 lb/10 gal.	2	.5475	.0038	.0069	
	16	.4388	.0074	.0169	
	23	.3013	.0013	.0042	
Average		.4292	.0042	.0098	98.53
Resmethrin .02 lb/10 gal.	10	.8620	.0000	.0000	
	11	.6535	.0000	.0000	
	22	.2307	.0000	.0000	
Average		.5810	.0000	.0000	100.00
Resmethrin .01 lb/10 gal.	20	.5425	.0000	.0000	
	21	.7308	.0000	.0000	
	24	.3532	.0013	.0037	
Average		.5401	.0004	.0007	99.89
Zectran .075 lb/10 gal.	12	.6570	.0000	.0000	
	18	.4045	.0000	.0000	
	26	.1114	.0000	.0000	
Average		.3925	.0000	.0000	100.00
Zectran .05 lb/10 gal.	1	.3178	.0000	.0000	
	14	.2907	.0000	.0000	
	27	.2044	.0000	.0000	
Average		.2713	.0000	.0000	100.00
Malathion .83 lb/10 gal.	3	.2162	.0000	.0000	
	7	.3063	.0000	.0000	
	13	.3773	.0000	.0000	
Average		.2995	.0000	.0000	100.00

Continued

Table 2. Continued

Treatment	Cluster number	Pre-spray density[1]	Post-spray density[1]	Survival ratio	Corrected % Control[2]
Malathion .21 lb/10 gal.	4	.3535	.0000	.0000	
	8	.3605	.0000	.0000	
	17	.3455	.0000	.0000	
Average		.3531	.0000	.0000	100.00
Check	5	.2903	.0787	.2711	
	9	.4646	.4136	.8902	
	15	.3355	.2398	.7148	
Average		.3629	.2432	.6702	

1 Larvae per linear inch of foliage.

2 100(1.0 - survival treated ÷ survival control) = corrected percent control.

DISCUSSION

The complete or near-complete control of pine butterfly larvae on the sample trees by application of all four materials was achieved with possible help from the following factors:

1. Small larvae size - Larvae on the sample trees were predominantly 1st and 2nd instar stages and, because of their small size, were very susceptible.

2. Larval feeding habits - Pine butterfly larvae are not protected by foliage growth, webbing, etc., as are some other defoliators, such as spruce budworm. Their habit of feeding and resting in exposed groups near the needle tips when small (Figure 7) makes them vulnerable to application of non-persistent sprays such as the four tested.

3. Amount of spray applied - All materials were applied to test trees to the point of run-off, making sure all foliage was wet. Open-grown ponderosa pines from 30 to 40 feet high were given an average of 10 gallons of spray.

Although the test sprays were applied with equipment that developed up to 200 psi pressure and was capable of reaching to heights of 50 feet and more, any of a variety of conventional sprayers available to private landowners would be sufficient to apply the material. The important consideration with non-persistent sprays would be to make certain the entire complement of foliage was covered.

Test results indicated that any of the four materials would be suitable for control of pine butterfly on yard, shade and other high-value trees by private home owners and land managers. Results showed that excellent control can be obtained with the low dosage rates (.01 lb/10 gallons for Resmethrin and stabilized pyrethrins, .21 lb/10 gallons for malathion and .05 lb/10 gallons for Zectran).

Figure 7. Exposed feeding and resting habit of pine butterfly larvae.

COOPERATORS

This pine butterfly ground spray test was a cooperative project involving the following agencies:

Montana Department of Natural Resources
and Conservation
Division of Forestry
Missoula, Montana

U.S. Forest Service, Region 1
Division of State and Private Forestry
Missoula, Montana

Insecticide Evaluation Project
PSW Forest and Range Experiment Station
Berkeley, California

Test materials were contributed by the following companies:

Dow Chemical Co.

McLaughlin Gormley King Co.

S.B. Penick and Co.

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